GENERAL ATOMICS

June 17, 1997
ENV - 2749

VIA FACSIMILE/EXPRESS OVERNIGHT
Yosh Tokiwa
U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street
M/C CMD-4-2
San Francisco, CA 94115

SUBJECT: Additional Information For A General Atomics Polychlorinated Biphenyl (PCB) Treatability Study

REFERENCE: General Atomics Notification Letter ENV-2739 Dated May 2, 1997 from Keith Asmussen to Yosh Tokiwa, U.S. EPA Region 9

Dear Mr. Tokiwa:

This letter is in response to your request on June 3, 1997 for additional information regarding the proposed PCB treatability study at General Atomics. Attached for your review are a set of responses to your request. Please note that the attached information contains proprietary information.

If you have any questions about the enclosed information, you may contact Paul Englert at (619) 455-2466 or my office at (619) 455-2823.

Very truly yours,

Keith E. Asmussen

Keith E. Asmussen, Director
Licensing, Safety and Nuclear Compliance

Enclosure: Supplemental Information Requested In Support of General Atomics' Proposed PCB Treatability Study

KEA:pfe PE061797.KEA

Supplemental Information Requested In Support of General Atomics' Proposed PCB Treatability Study - June 18, 1997

1. Background of General Atomics

General Atomics (GA) and its affiliated companies comprise one of the world's leading resources for high technology systems development and nuclear technology. GA specializes in diversified research and development in energy, defense and other advanced technologies, many for environmentally sensitive applications.

Founded in 1955 as a division of General Dynamics, GA is now privately owned. The company had an initial charter to explore peaceful uses of atomic energy. Many leading scientists came to GA, forming the nucleus of a staff that currently numbers about 1,200.

GA is the primary developer of gas-cooled nuclear power reactor technology in the United States, and it carries out the largest and most successful fusion energy research programs in private industry. The company and its affiliates develop and build state-of-the-art unmanned aerial vehicles, and provide information technologies, TRIGA research reactors, electronic instrumentation and superconducting magnets. GA's pioneering technology development continues to create new business areas.

GA's Advanced Technologies Group demonstrates new technologies: it has designed robotics process lines for safe disposal of obsolete chemical munitions; it is developing supercritical water oxidation systems; and it carries on extensive programs in the fields of advanced materials and electromagnetic technologies.

For 40 years, GA has been qualified by the U.S. Government and other organizations, including the Department of Energy, Department of Defense and the National Science Foundation, as a government contractor and facilities operator.

The company's main facilities are located on a 120-acre site in San Diego, California and contain nearly one million square feet of engineering and test facilities, precision manufacturing installations and advanced technology laboratories. GA and its affiliates also conduct operations from Zurich, Berlin, Dresden, Moscow, Tokyo, Denver, and Washington, DC.

2. Work Plan for Supercritical Water Oxidation (SCWO) PCB Study, Including Anticipated Time Schedule, Sampling and Analysis Plan, and Disposition of Residuals and Effluents

The current version of the Statement of Work for GA's Test Scope as "Consultant" for our client as "Engineer" is attached (Attachment I) as a draft document. It describes the work to be performed, quantity of material processed, throughput rate, sampling requirements, health and safety requirements, and disposition of materials at the completion of testing. The following is an anticipated schedule based upon the information available at this time:

Anticipated Schedule

	Task	Target Date
1.	Obtain TSCA approval to perform tests	July 1
2.	Negotiate test scope and execute agreement with Owner	July 15
3.	Transport 4 drums uncontaminated sludge and 1 drum PCB-contaminated sludge to GA	July 22
4.	Submit Detailed Schedule of Activities 10 days prior to testing	July 15
5.	Submit Sampling Plan and Procedures 7 days prior to testing	July 15
6.	Submit Health & Safety Plan 3 days prior to testing	July 22
7.	Complete Simulant Testing (uncontaminated sludge)	Aug. 1
8.	Complete PCB-contaminated Sludge Testing within 30 days of execution of agreement	Aug.15
9.	Complete decontamination of pilot plant and disposal of contaminated materials	Sept. 15
10.	Complete data analysis and final report within 60 days of testing completion	Oct. 15

The sampling and analysis plan, and disposition of residuals and effluents, are discussed in the statement of work.

3. SCWO Oxidant and Residuals

The oxidant used in the SCWO process is air.

4. List of Equipment to be Used In the SCWO PCB Study

A list of the equipment that may become contaminated with PCB sludge is provided below. A Process Flow Diagram showing the major system components is attached for reference (Attachment II). All handling and decontamination procedures will be documented in the SCWO PCB Health and Safety Plan (contract requirement) and the Hazardous Work Authorization (GA requirement). Many of these procedures are already in place for ongoing uncontaminated sewage sludge testing. These current procedures will be updated and expanded for the PCB sludge tests. Decontamination procedures include flushing of lines and equipment with various industrial solvents such as kerosene and ethanol, and disassembly and cleaning of selected components. All decontamination solutions will be collected and disposed of as hazardous waste, in compliance with 40 CFR 61.

List of Equipment

A.	Sludge Preparation Equipment for thickening or diluting the sludge (including drums, drum pumps, mixers, gorator/emulsifier). (See Attachment II.)
B.	Sludge High Pressure Pump module (including drum pump, dual syringe pump, and piping). (See Attachment II.)
C.	SCWO Skid (including valves, piping, preheater, SCWO reactor, heat recovery heat exchanger, and pressure letdown system). (See Attachment II.)
D.	Effluent Collection and Sampling System (including piping and collection drums).

5. Processing Rate

The planned processing rate through the SCWO system will be about 1.5 to 2.5 kg/min. of sludge at a concentration of 10% solids. The sludge is expected to have a concentration of about 20% solids, thus requiring 1:1 dilution with water to achieve a pumpable 10% concentration. The throughput rate of as-received sludge will therefore be about 0.75 to 1.5 kg/min. (1.6 to 3.3 lb/min.). Therefore, the total processing time for 500 lb (1 drum) of PCB-contaminated sludge will be about 2.5 to 5.2 hours. The actual feed rate will be selected based upon the uncontaminated sludge (simulant) test results.

6. Required Permits

GA maintains the following permits which are applicable to this treatability study:

Permit	Agency	Number
Health Permit	San Diego County DEH	H14873
EPA ID Number	U.S. EPA	CAD 067 638 957
Exemption	San Diego APCD	Laboratory Equipment
Industrial User Discharge	City of San Diego	02-0059

ATTACHMENT I

STATEMENT OF WORK FOR TREATABILITY TESTING OF PCB-CONTAMINATED SEWAGE SLUDGE

A. INTRODUCTION

The Owner is currently in the process of closing eight sludge storage lagoons at its wastewater treatment plant. Five of the lagoons are contaminated with PCBs at levels ranging from 50 to 3000 mg/kg. The PCB contaminated sludge is stored in five lagoons, totaling over 100,000 dry tons with an average age of approximately 20 years. The characteristics of the PCB contaminated sludge are summarized in Table 1. The Owner intends to Close the lagoons based on a non-incineration process in accordance with the PCB destruction variance provisions found in 40 CFR 761.60(a)(5).

The Owner has evaluated non-incineration treatment technologies, and has selected Supercritical Water Oxidation (SCWO) as a preferred method of disposal. Supercritical Water Oxidation (SCWO) is an innovative technology which has never been used for PCB destruction in other than laboratory experiments. However, the process has been studied extensively for the last twenty years. Laboratory data strongly indicate that PCB destruction is completely feasible with this process.

To protect the Owner from unnecessary financial exposure, Engineer has proposed to conduct pilot scale testing to demonstrate the effectiveness of the SCWO process in destroying the PCB lagoon sludges. The "demonstration" testing will require the Consultant to prove that the SCWO system is effective in destroying PCBs. TSCA requires that alternative destruction methods have equivalent or greater destruction efficiencies than incineration. Therefore, the goal of this pilot study is to demonstrate that a comparable destruction efficiency can be reliably achieved.

B. CONSULTANT REQUIREMENTS

SCWO treatability testing is required to demonstrate proof-of-process for the destruction of PCB contaminated anaerobically digested domestic sewage sludge. Specific requirements for the treatability testing are as follows:

- Consultant shall posses a TSCA permit to perform the required treatability testing of PCB contaminated sludge.

- Consultant shall, at the completion of testing, transport any remaining PCB sludges that are not feasible to process at Consultants facility to Owner's facility or to a TSCA approved disposal facility as approved by Engineer.

- Consultant shall submit to Engineer at least seven days prior to testing a pilot testing and sampling plan including a process schematic illustrating intended sampling points. Process specific sampling methods shall be fully described.

- Consultant shall perform pilot-scale treatability testing of PCB contaminated sewage sludge to identify process requirements necessary to achieve acceptable waste destruction. A TSCA permitted pilot plant with a capacity of not less than 0.3 gpm shall be used for all testing.

- Consultant shall allow Engineer to oversee all testing and sampling activities without obstruction.

- All testing shall be conducted in a schedule mutually agreeable to Consultant and Engineer. Consultant shall provide Engineer with schedule of activities at least ten days prior to start of pilot testing. All testing shall be complete within 30 calendar days of execution of agreement by Owner.

- Consultant shall characterize all SCWO process effluents for documentation of PCB destruction efficiency.

- Consultant shall characterize SCWO effluents sufficiently for Engineer to evaluate disposal or discharge requirements for environmental compliance.

- Consultant shall prepare a report, including testing evaluation and additional test requirements, for remediation of the City of Dayton PCB sludge storage lagoons. In the report, Consultant shall submit a

budgetary estimate for remediation of the PCB sludges at the Dayton Wastewater Treatment Plant. The report shall evaluate the SCWO process in the use of three non hazardous wastewater sludges to slurry PCB sludges and provide additional BTU content. Evaluation will be based upon Engineer provided information. The three sludges to be considered are: 1) lagooned anaerobically digested sludge approximately 20 years old; 2) the City's current production of anaerobically digested sludge; 3) the City's current production of primary and waste activated sludge without anaerobic digestion.

TASK 1 - PRE-TEST ACTIVITIES

Consultant shall have or develop prior to testing, a Health and Safety Program for work with hazardous wastes, including a specific Plan for testing PCB materials. The Program and Plan shall be compliant with 29 CFR 1910 and other applicable OSHA regulations. Consultant shall provide Engineer a copy of the health and safety plan at least three days prior to testing. Engineer shall operate under and comply with at all times Consultants health and safety plan. Consultant shall provide Engineer with any health and safety equipment required under Consultants health and safety program throughout the duration of testing.

Consultant shall transport four drums of uncontaminated sludge and one drum of PCB sludge to Consultant's facility. Sludge is staged and ready for transport at Owners facility in Dayton Ohio. PCB sludge is labeled in accordance with Federal regulations.

Equipment modifications and inspections shall be made to prepare the pilot plant for the treatability testing. In particular, the SCWO feed system shall be prepared for feeding digested, aged sewage sludge. Feed system tests will be performed to verify that adequate pumping, size-reduction, and mixing capabilities are available to insure reliable performance to the SCWO feed system.

TASK 2 - SIMULANT TESTING

Simulant testing shall be performed in advance of PCB contaminated sludge testing to establish the preferred operating conditions. Simulant wastes will be easier to work with and will not reduce the quantity of actual PCB waste that can be treated under TSCA permit. Uncontaminated digested sludge from the non-PCB-contaminated lagoons shall be provided to Consultant to be utilized as the waste sludge simulant. Consultant may use a suitable dopant to simulate PCBs for analytical purposes at Consultants discretion. Auxiliary fuel and/or heat recovery or preheating will be used to insure energy sufficiency and make up for the heat value removed during anaerobic digestion. If required, methanol and ethanol shall be used for auxiliary fuel without exception. Simulant testing shall be conducted on a feed with a solids concentration of 10% or as approved by Engineer. Four 55-gallon drums of uncontaminated, digested, aged lagoon sludge shall be provided to Consultant to support the simulant testing. In addition, Consultant may, at his discretion with approval of Engineer, obtain and test anaerobically digested sludge obtained from a local domestic wastewater treatment facility.

Specific activities to be performed during simulant testing will include:, (1) preparation and performance of sludge pumping tests with thickened sludge to ensure compatibility with high-pressure pumps, (2) feed system modifications as required to insure reliable feed, and (3) identification and implementation of sludge handling methods to maintain protection of human health and the environment.

The simulant testing shall be supported by mass and energy balance calculations as is technically feasible and by routine sampling and analyses of process effluents. Varying conditions of pressure, temperature, flow and sludge density will be tested to determine adequate destruction conditions, with appropriate margin, for simulant sludge and dopant if used.

TASK 3 - PILOT TESTING

Following completion of simulant testing to establish the required pilot test conditions, one test at minimum will be performed with PCB contaminated sludge in combination with heat recovery and/or auxiliary fuel in order to evaluate time at temperature requirements for sufficient destruction of PCBs. If required, methanol and ethanol shall be used for auxiliary fuel without exception. Pilot testing shall be conducted on a feed with a solids concentration of 10% or as approved by

Engineer. Approximately 500 pounds of PCB contaminated, digested, lagoon sludge shall be provided to Consultant to support pilot testing. All PCB sludge shall be processed through the pilot reactor regardless of the number of discrete tests performed. All PCB sludges shall be processed in an oxidizing environment with 3% excess oxygen at minimum. The testing will be supported by mass and energy balance calculations as well as by routine sampling and analyses of process effluents.

The results of the treatability tests will be used to establish suitable production-scale operating parameters needed for sufficient destruction of the PCB contaminated sludge, and to support an economic analysis for scale-up to a production-scale system for the Owner.

TASK 4 - SAMPLING AND ANALYSES

Consultant shall collect all samples in a manner acceptable to Engineer. Consultant shall provide to Engineer a summary of sampling procedures for all testing at least seven days prior to any testing.

Routine sampling and analysis requirements will include on-site analysis of liquid effluents for pH, conductivity, and TOC, plus on-line gas analyzers for measurement of CO, O_2, and organic vapors/hydrocarbons during testing. Consultant shall continuously monitor flow rates of all influents and effluents to support mass balance calculations. Detection limits for CO, O_2 and Organic Vapors (or total HC) shall be 10ppm, 10,000ppm and 0.1ppm respectively.

Chemical analyses beyond the analyses identified above will be provided by Engineer's laboratory. Liquid samples will be collected at least every 1/8th of anticipated test run (i.e. for 2hr run, every 15 min) in support of analytical services arranged by Engineer. Each sample volume will be 3 liters at minimum. Gas samples will be collected once during each run of pilot testing while the system is operating in steady state conditions in support of analytical services arranged by Engineer. Liquid effluent shall be allowed to settle so that ash and insoluble fractions may be sampled independently of soluble wastes. Settled ash will be sampled at the end of pilot testing as a composite sample and will be analyzed by Engineer's laboratory.

Composite samples will be collected for analysis. In general, one composite sample will be analyzed for each of the five tests, and occasionally two composite samples per test for some of the liquid effluent analyses. For the two PCB-contaminated sludge tests, an additional baseline sample will be taken of the feed material for PCB and metals analyses.

The analyses to be performed for each test are included on attached Tables 2 and 3.

TASK 5 - POST TESTING ACTIVITIES.

Process residuals and drums from treatment of non PCB sludges shall become property of Consultant after testing and sampling is complete.

The PCB shipment drum shall be triple rinsed with a TSCA approved solvent in accordance with 40 CFR 761.79. Physical cleaning of drum shall be performed prior to triple rinsing if appropriate. A wipe sample shall be collected and submitted to Engineers laboratory for analysis. It is anticipated that drum(s) and residuals will not be classified as TSCA or hazardous wastes. Process residuals and drum(s) from treatment of PCB sludges shall be disposed by Consultant. Consultant shall certify PCB disposal in accordance with 40 CFR 761.218

If treatment of all TSCA wastes is not technically feasible, Consultant may, with approval of Engineer, transport wastes to Owner's facility or other approved TSCA disposal facility.

TASK 6 - REPORTING AND PROPOSAL

At the conclusion of testing, Consultant shall prepare and deliver to Owner a report of findings within 60 calendar days of pilot test completion. The report shall be organized in the following manner:

ES Executive Summary
1. Introduction and Purpose
2. Pilot testing equipment and configuration

3. Pre-testing Optimization
4. Simulant testing results
5. Pilot testing results
6. Conclusions (w/identification of known hazardous chemicals in effluents, potential process concerns, and budgetary estimates for full scale implementation)
7. Appendices

    Analytical results, mass balance calculations, pressure and temperature traces, disposal certification, etc.

The results of the treatability tests will be used to define the system requirements for a production-scale SCWO system for treatment of the City of Dayton sludge storage lagoons. Assumptions used for scale-up of the equipment and operating parameters, and/or extrapolation of the pilot-scale test data, will be defined as well as the need for additional testing. These system requirements will enable a decision to be made by the City of Dayton to proceed to Phase II and the design and construction of a production-scale system.

In parallel with the treatability testing report of findings, process/waste evaluation and economic analyses will be performed to guide the work and keep it focused toward the definition of an economically viable production-scale SCWO system. The economic analyses will include a cost proposal and schedule of activities for full scale implementation.

C. OWNERS REQUIREMENTS

Provide Consultant with four 55-gallon drums of non-PCB sludge, and 500 pounds (55-gallon drum) of PCB sludge for testing.

D. ENGINEERS REQUIREMENTS

Engineer shall maintain confidentiality of Consultant's process and procedures and shall not disclose any information, other than information contained in Consultants report which shall be a public document, to other parties without the express consent of Consultant.

Engineer shall operate under Consultants health and safety plan. Engineer shall not interfere with Consultants testing. However, Engineer shall oversee collection of all pilot test samples. Engineer shall maintain custody of all samples and shall deliver samples to Engineer's selected laboratory via overnight courier. Engineer shall forward copies of all analytical data to Consultant within three days of receipt from laboratory.

Engineer shall provide Consultant with characterization of the PCB and non-PCB contaminated sludges which will be provided to Consultant for simulant and pilot testing. Analyses performed by Engineer are shown on Table 4.

TABLE 1

Summary of Information for PCB Contaminated Sludge Storage Lagoons

Physical Parameters

Parameter	Units	Quantity
Surface area, each	acres	1.2, 5.4, 2.3, 1.8, 2.2
Depth of sludge	feet	10 to 30
Quantity of sludge, total	dry tons in-place wet tons	105,000 450,000
Total solids	percent	5 to 35

Constituent Concentrations

Parameter	Type of Sample	Range	Average[1]
PCBs, mg/kg	Composite	81 to 880	260
PCBs, mg/kg	Grab	<1 to 2,800	N/A
Metals, mg/kg	Composite		
Arsenic		5.6 to 9.7	7.9
Cadmium		298 to 458	389
Chromium		2,420 to 3,470	2,704
Copper		2,420 to 2,750	2,578
Lead		2,460 to 4,340	3,396
Mercury		<0.20 to 3.8	2.1
Molybdenum		20 to 39	25
Nickel		220 to 530	362
Selenium		1.3 to 5.7	3.4
Zinc		7,270 to 10,040	8,630
Potassium		278 to 1,140	571
Cyanide, mg/kg	Composite	9.6 to 117	62
Ammonia, mg/kg	Composite	1,500 to 2,070	1,830
Phosphorous, mg/kg	Composite	9.2 to 77	32
Total Kjeldahl Nitrogen, mg/kg	Composite	2,510 to 8,840	5,430
Total Organic Nitrogen, mg/kg	Composite	645 to 6,790	3,595
CFUs/gram	Composite	25,000 to 80,000	47,000
All lagoons passed the TCLP test.			

[1] Weighted Average

TABLE 2

Analysis of Simulant Test Effluents[1]

Analyses To Be Provided By Consultant:

Analysis	Combined Effluent	Settled Ash	Decant
Dopant	?	?	?
TOC	1	--	--
COD	1	--	--
TSS	1	--	--
VSS	1	--	--
TS	1	--	--
TVS	1	--	--

Analyses To Be Provided By Engineer: None

[1]The number "1" means one analysis will be conducted.

TABLE 3

Analysis of Pilot Test Effluents[1]

Analyses To Be Provided By Engineer:

Analysis	Off-gas	Effluent	Settled Ash	Decant
PCBs (8080)	1	1	--	--
TCLP (RCRA Metals)	--	--	1	--
ICP Metals + Mercury (6010)	--	--	--	1
VOA (8240/8260)	--	1	--	--
Semi-Volatiles (8270)	--	1	--	--
Dioxins/Furans	1	1	--	--
TOC	1	--	1	1
COD	--	--	--	1
Ammonia Nitrogen	--	--	--	1

Analyses To Be Provided by Consultant:

Analysis	Effluent	Settled Ash	Decant
TSS	1	--	--
VSS	1	--	--
TS	1	--	--
TVS	1	--	--
TOC	1	--	--
COD	1	--	--

[1]The number "1" means one analysis will be conducted.

TABLE 4

Analysis of Raw Sludge[1]

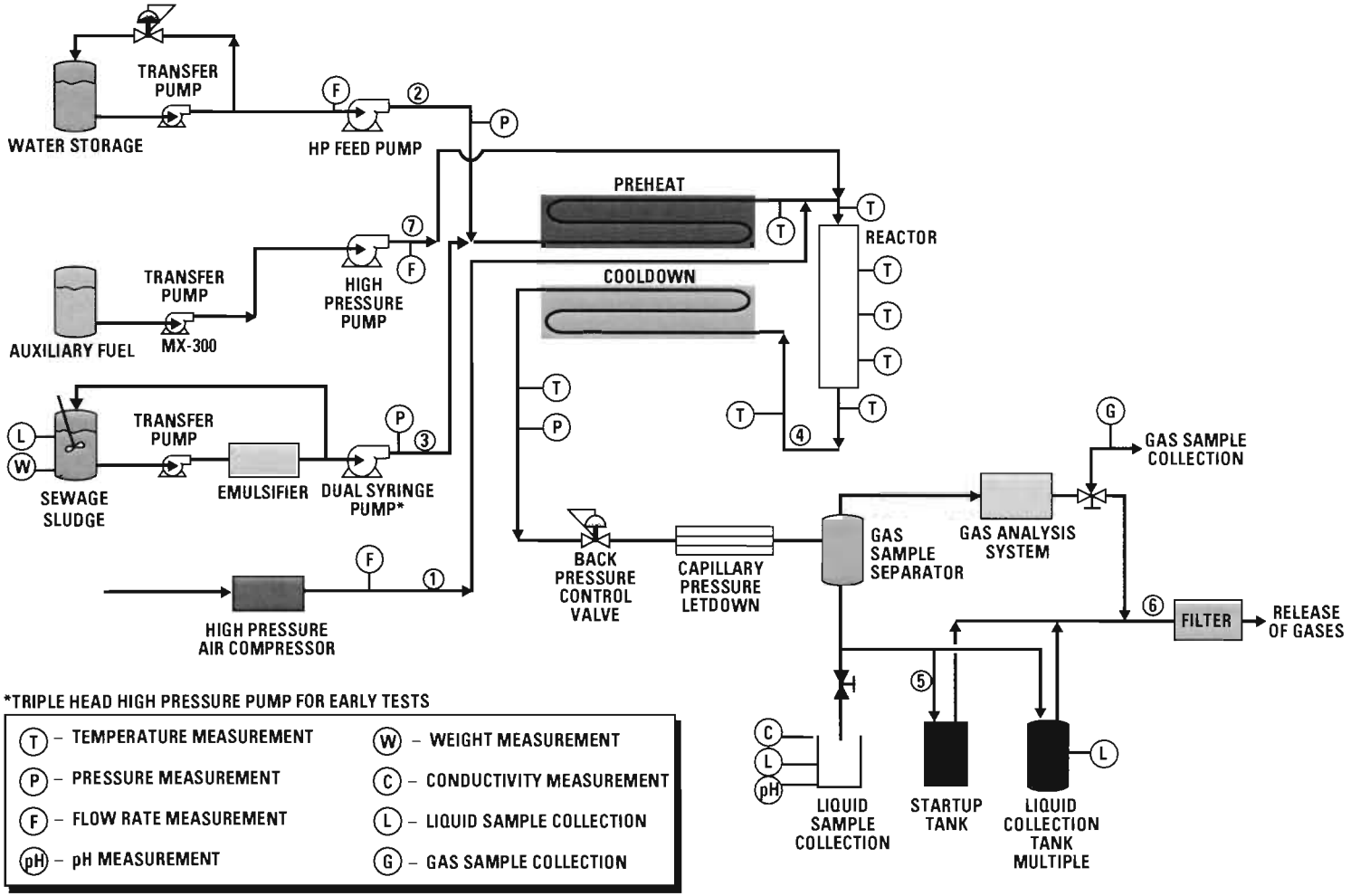
Analyses Provided By Engineer:

Analysis	PCB Sludge	Non-PCB Sludge
TCLP (RCRA Metals)	1	1
PCBs (8080)	1	--
Dioxins	1	--
VOA (8240/8260)	1	--
Semi-VOA (8270)	1	--
ICP Metals + Mercury (6010)	1	--
TOX	1	1
TOC	1	1
COD	1	1
Ammonia Nitrogen	1	1
TSS	--	--
VSS	--	--
TS/Moisture Content	1	1
TVS	1	1
BTU Content	1	1

[1]The number "1" means one analysis will be conducted.

ATTACHMENT II

PROCESS FLOW DIAGRAM FOR SEWAGE SLUDGE TESTS



*TRIPLE HEAD HIGH PRESSURE PUMP FOR EARLY TESTS

(T) – TEMPERATURE MEASUREMENT	(W) – WEIGHT MEASUREMENT
(P) – PRESSURE MEASUREMENT	(C) – CONDUCTIVITY MEASUREMENT
(F) – FLOW RATE MEASUREMENT	(L) – LIQUID SAMPLE COLLECTION
(pH) – pH MEASUREMENT	(G) – GAS SAMPLE COLLECTION

ADDING POLYMER TO SEWAGE SLUDGE

L-883(4)
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THICKENING SEWAGE SLUDGE

L-883(3)
5-15-97

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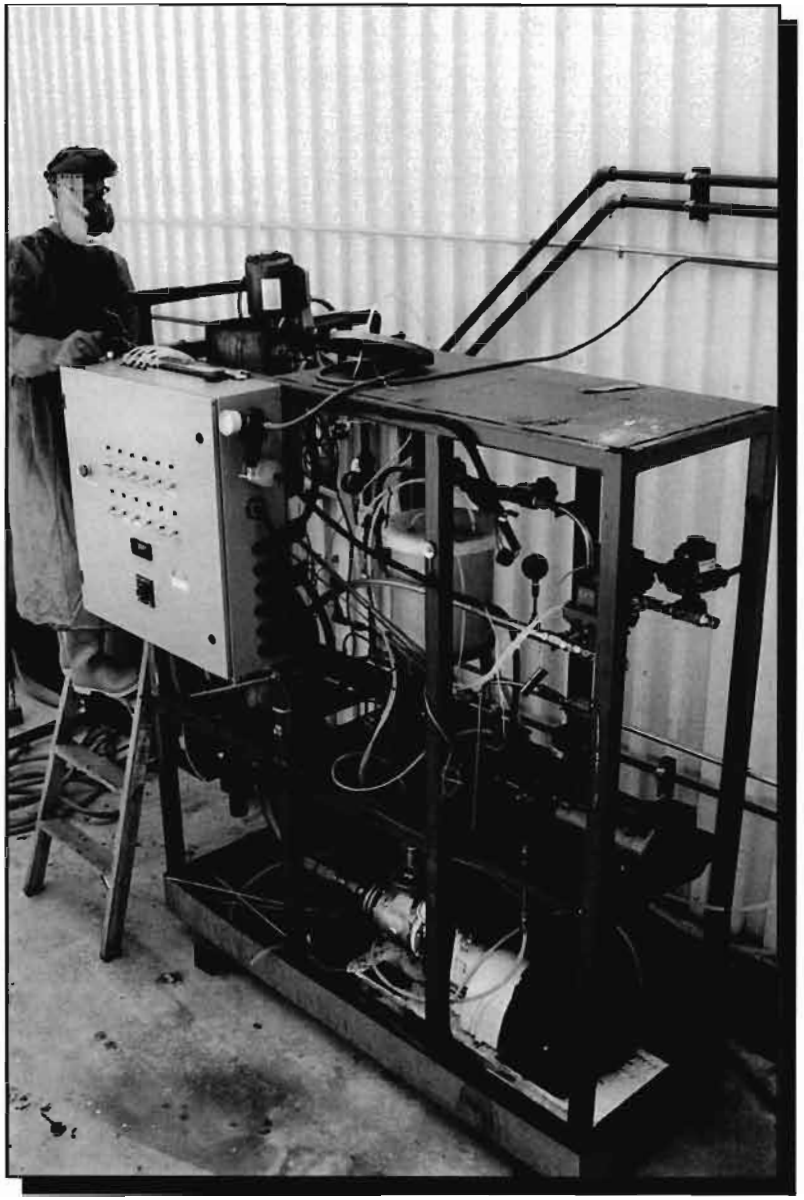
SLUDGE GORATOR SYSTEM



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SLUDGE FEED SYSTEM

L-883(6)
5-15-97

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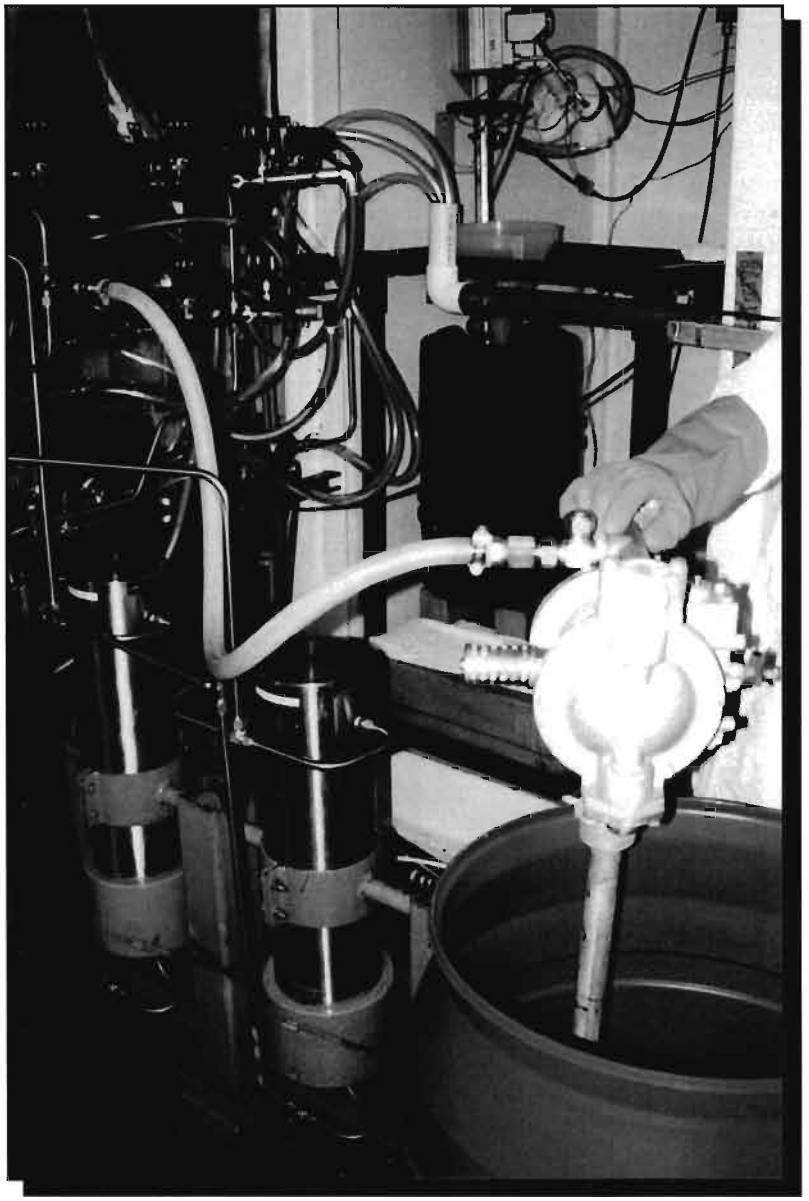
SLUDGE HIGH-PRESSURE FEED PUMP



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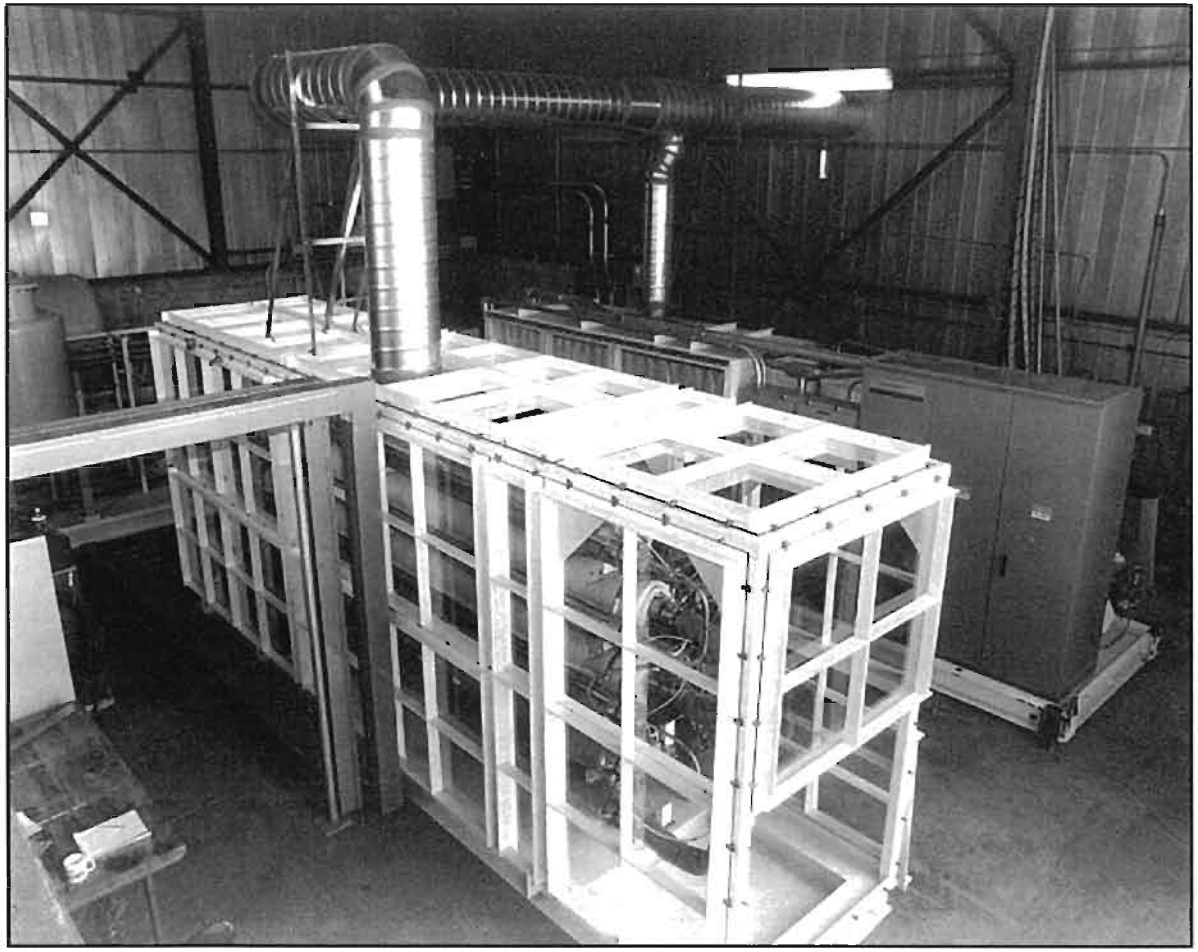
PILOT PLANT USED TO DESTROY SEWAGE SLUDGE



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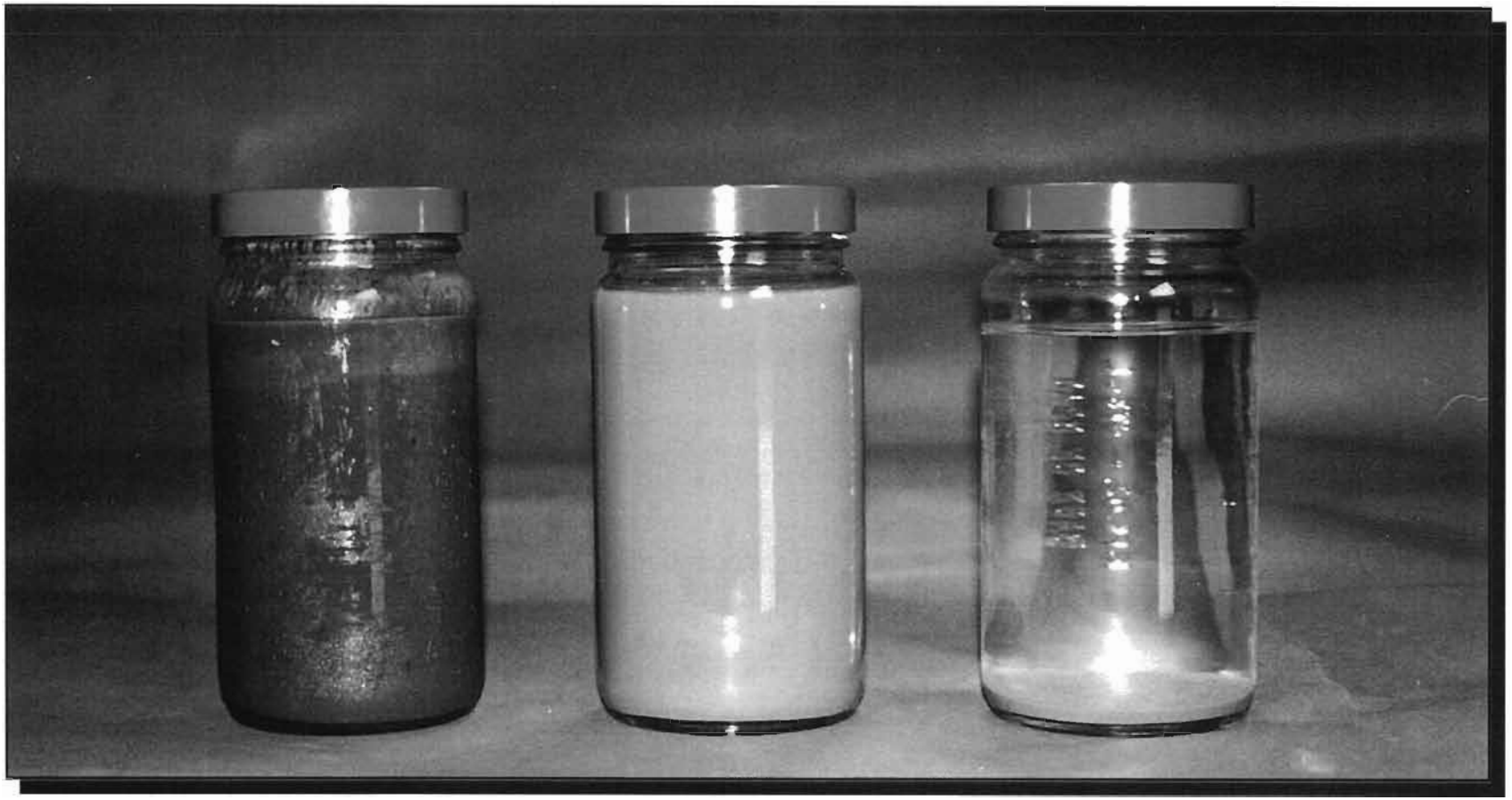
FEED AND EFFLUENT SAMPLES



Sewage
Sludge Feed

SCWO
Effluent
(before settling)

SCWO
Effluent
(after settling)

L-883(2)
5-15-97

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U.S. Nuclear Policy for the Future

- U.S. nuclear percentage at least remains constant
- Share and encourage best nuclear technology abroad
- Expand nuclear use in transportation
  - hydrogen
  - electrical base, hybrid range extension
- Pursue the technical breakthrough with Russia